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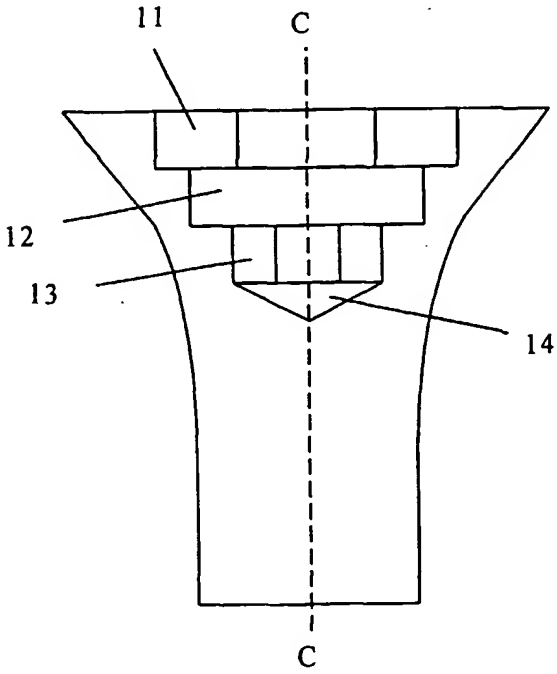
(54) Title: DRIVING HEADS FOR FASTENERS



(57) Abstract: Fastener (1) having a driving head (2) which includes at least two superimposed non-circular recesses (3, 4, 5) for receiving the bit of a driver (7) with which driver a torque can be applied to operate the fastener (1), characterised in that the fastener (1) comprises a security feature whereby said torque needs to the applied to at least two of said recesses (3, 4, 5) in order to operate the fastener (1).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

DRIVING HEADS FOR FASTENERS

This invention relates to the field of driving heads for fasteners, for example screws, and a driver (for example a screwdriver) therefor.

The invention relates more particularly to the "torque receiving element" (hereinafter referred to as a "driving head") of fastenings which require rotation in order to install them. Generally such fasteners, for example bolts, screws etc. are threaded. However, it is envisaged that the present invention is also applicable to non-threaded fasteners whose function is dependent upon rotation about their longitudinal axis.

There are a number of well-known disadvantages with conventional driving heads. For example, driving heads having a recess in which a mating driver is engaged suffer from the problem known as "cam-out". This is the tendency of the driver and mating recess to move axially apart under an applied torque as a result of the torque transmitting forces which are inclined at a small angle to the longitudinal axis of the fastener. The problem is created by the faces of the recess in the driving head being inclined. This inclination or "draw" is necessary during the manufacturing process in order to facilitate the extraction of the punch used to form the recess. Failure to provide sufficient "draw" or angle of release for the punch, results in damage to the punch and/or to the recess being formed.

Cam-out requires the operator to apply a counter balancing force to the screwdriver, which results in operator fatigue. Where there is an imbalance between the two forces, the screwdriver moves axially out of the

recess in the driving head, causing wear to the engaging faces of the driver and recess as well as potential damage to the adjoining surfaces.

Another disadvantage of "draw" is that mere insertion of a driver into a recessed driving head is not sufficient to allow the fastener to be carried by frictional contact between the driver and recessed driving head. The need to insert a fastener into difficult locations would be greatly facilitated if the driver could carry the fastener to the location where it is required.

A further problem with existing driving heads is that a whole range of mating drivers is required to install the full range of fasteners which are available. If the operator is tempted to use a "makeshift" driver, the driving head of the fastener can be damaged.

The above-described problems are alleviated by use of a multi-tiered screw and screwdriver therefor, as described in GB1150382 (Podolsky). The multi-tiered screw described therein has a recess or "socket" formed in the head of the screw which has a number of interior faces all parallel to the longitudinal axis of the screw. Using a correspondingly shaped screwdriver, it is possible to achieve an interference fit between the screw and screwdriver, thus allowing the operator to insert the screw into an awkward position using the screwdriver itself.

A further advantage of the Podolsky screw and screwdriver is that a single screwdriver can be used with a range of different screw sizes. This is possible because, as the diameter of the driving head increases, more tiers of the same screwdriver can be contained within the tiered

recess in the driving head. Therefore, when working with a large range of differently-sized screws, the number of screwdrivers which need to be kept to hand is reduced.

However it is apparent that if many screws can be turned with a single screwdriver then security is reduced, which may be a problem if it means equipment of a hazardous or sensitive nature is readily accessible.

There is thus a need for a multi-tiered fastener and driver which have the advantages of the Podolsky screw and screwdriver but with improved security features. It is an object of the present invention to provide such a fastener and driver.

According to a first aspect of the present invention there is provided a fastener having a driving head which includes at least two superimposed non-circular recesses for receiving the bit of a driver with which driver a torque can be applied to operate the fastener, characterised in that the fastener comprises a security feature whereby said torque needs to be applied to at least two of said recesses in order to operate the fastener.

Preferably, the security feature further comprises at least one of said recesses having a different diameter and shape to the other(s).

Preferably, said at least one recess is differently shaped in lateral cross-section. Alternatively, said at least one recess has the same shaped lateral cross-section, but is rotationally displaced.

In a preferred form, the longitudinal axes of at least

two recesses are not co-linear.

In a further preferred form, at least one of said recesses approximates a circle in lateral cross-section. Ideally, said recess approximating a circle in lateral cross-section is an ellipse.

Preferably, the height of at least one of said recesses is in the range 0.5mm to 2mm inclusive. Ideally, said height is 1mm.

Preferably, the ratio of height to diameter of at least one of said recesses is in the range 0.8 to 1.2 inclusive.

Preferably, the diameter of at least one of said recesses is not a standard metric or imperial size.

According to a second aspect of the invention there is provided a driver for use with a fastener as described in any of the preceding paragraphs, having a bit of complementary shape to at least two of the recesses of the fastener. Preferably, the longitudinal axis of the driver is, in use, co-linear with the longitudinal axis of the fastener.

According to a third aspect of the invention there is provided a forming tool for forming a fastener, as described in any of the preceding paragraphs, having a punch of complementary shape to the desired recesses of the fastener.

Preferably, said punch has a pointed end, the point having an angle in the range of 6°-30° inclusive. Ideally, said angle is 25°.

Preferably, in use, the pointed end is within 0.3mm of the longitudinal axis of the fastener being formed.

According to a fourth aspect of the invention, there is provided a push-fit cap for use with a fastener as described in any of the preceding paragraphs, having a complementary shape to at least two of the recesses of the fastener.

Preferred embodiments of the invention will now be more particularly described, by way of example, with reference to the accompanying drawings in which:

Figure 1 is an axial section of a prior art multi-tiered fastener, having three different "tiered" sizes of female recess;

Figure 2 is a side view of a prior art driver for use with the fastener shown in Figure 1;

Figure 3 is a top view of the recesses in the driving head of the fastener shown in Figure 1;

Figure 4 is a top view of the recesses in a driving head embodying the first aspect of the invention;

Figure 5 is a top view of an alternative embodiment of the recesses in a driving head according to the first aspect of the invention;

Figures 6-8 are top views of further embodiments of the recesses in a driving head according to the first aspect of the invention, wherein at least one recess is rotationally displaced;

Figures 9-11 are top views of further embodiments of the recesses in a driving head according to the first aspect of the invention, wherein at least one recess is axially offset;

Figures 12 and 13 are top views of further embodiments of the recesses in a driving head according to the first aspect of the invention, wherein at least one recess is an ellipse;

Figure 14 is a top view of the recesses in a driving head embodying the second aspect of the invention;

Figures 15 and 16 are top views of further embodiments of the recesses in a driving head, wherein the recesses are elliptical;

Figures 17A and 17B are axial sections of a fastener according to the first aspect of the invention, having recesses as shown in Figure 10; and

Figures 18A and 18B are side views of a driver embodying the third aspect of the invention, suitable for use with the fastener of Figures 17A and 17B.

Figure 1 shows a prior art screw 1 having a driving head 2 which includes three hexagonal female torque-receiving recesses 3, 4, 5 of decreasing diameter (as one moves away from the top surface 6 of the screw 1). Screws of smaller dimensions may have only two recesses (3,4) or indeed a just a single recess (3). Similarly, larger screws having more than three recesses may be provided.

Throughout this description, the "height" of a recess is the dimension parallel to the longitudinal axis of the screw, indicated as H in Figure 1. The recess "diameter" is the longest dimension parallel to the top surface 6 of the screw, indicated as D in Figure 1.

Figure 2 shows a side view of a prior art driver 7 suitable for use with any of the differently-sized screws in a particular series. The driver bit has a complementary shape to the recesses in the driving heads of the screws. In the illustrated example, the driver 7 has three tiers 8, 9 and 10. When the driver 7 is engaged with the screw 1 illustrated in Figure 1, all three tiers 8, 9 and 10 engage in the three recesses 3, 4 and 5 respectively.

If the driver 7 was being used with a screw having only two recesses, only tiers 9 and 10 would be in driving engagement with the screw. Similarly, if the driver 7 was being used with a screw having only one recess, only tier 10 would be in driving engagement with the screw. The torque applied by a single tier, tier 10 in this instance, would be sufficient to operate the screw.

In this way, a single driver 7 can be used with numerous differently-sized screws, so long as the recesses are of the same shape; hexagons, in the illustrated example.

In order to improve security and minimise unauthorised tampering, it is proposed to provide a driving head which requires a dedicated driver to operate it owing to the security features of the driving head. The first security feature is that the height H of each recess is not great enough to allow sufficient torque to be applied to the screw via only one tier of a corresponding

screwdriver bit. Therefore the screwdriver needs to match at least two of the recesses on the driving head of the screw.

Further security features can be provided in a number of ways. For example, with reference to Figure 4, a driving head can be provided in which the shape of at least one recess (in lateral cross-section) differs from the other two. In the illustrated example, the largest and smallest recesses (11 and 13 respectively) are hexagonal in shape. The intermediate recess 12 is a pentagon.

As shown in Figure 5, it is possible for all three recesses 11, 12 and 13 to differ in shape. In Figure 5, the largest recess 11 is a hexagon, the intermediate recess 12 is a pentagon and the smallest recess 13 is a triangle.

It will be appreciated that a very large number of combinations of differently-shaped recesses is possible. For example, the lateral cross-sectional shape of each recess could be a regular polygon, an ellipse, an "eye" shape, a lobed figure or any combination thereof.

In addition or as an alternative to the above-described security features, it is also possible to provide a recesses in the driving head as illustrated in Figures 6-8. In these examples, at least two of the recesses have the same basic cross-sectional shape but are rotational displaced from one another.

For example, in Figure 6, all three recesses 11-13 are hexagonal. However, the intermediate recess 12 is rotationally displaced or misaligned with the other two recesses. Therefore a standard three-tiered hexagonal

driver, such as the type described in Podolsky (GB1150382) could not be used to operate a fastener having recesses in the driving head as illustrated in Figure 6.

It is possible, as shown in Figure 7, for all three recesses 11-13 to be rotationally displaced from one another.

Furthermore, as shown in Figure 8, the rotational displacement security feature can be combined with the differently-shaped recess feature. In Figure 8, the two hexagonal recesses 11 and 13 are rotationally displaced from one another. The intermediate recess 12 has a pentagonal cross-sectional shape.

Turning now to Figures 9-11, a further security feature is introduced. In the previously-described embodiments, all of the recesses 11-13, regardless of their shape and rotational alignment, have been centred about point C (shown in Figure 8) which corresponds with the longitudinal axis of the fastener (see Figure 1 for side view). Throughout this description, the "longitudinal axis" of a recess is the axis parallel to the side walls of the recess and, in the previously-described embodiments, co-linear with the longitudinal axis C of the fastener.

In the embodiments illustrated in Figures 9-11, the longitudinal axis of at least one of the recesses is axially displaced from the longitudinal axis C of the fastener i.e. is not co-linear with axis C.

In Figure 9, for example, the intermediate recess 12 is axially displaced from the axis C.

This feature can be combined with others of the previously-described features. For example, as shown in Figure 10, it is possible to combine differently-shaped recesses (two hexagons and one square) with at least one of the recesses being axially displaced from axis C.

It is preferable for the smallest recess 13 to be coaxial with the axis C, as shown in Figures 9 and 10. However, it may be possible to offset even the smallest recess 13, as shown in Figure 11. In all cases, but particularly in the Figure 11 embodiment, it is important for the longitudinal axis of the screwdriver to be colinear with axis C when the screwdriver is in use.

The part of recess 13 shown dotted in Figure 11 would not be necessary (or visible), given the location of the offset intermediate recess 12.

As mentioned above, one or more of the recesses can be elliptical in lateral cross-section, as illustrated in Figures 12 and 13 in which the intermediate recess 12 is elliptical.

There is a significant advantage not envisaged in the prior art in using recesses in a multi-tiered fastener which approximate a circle. If the geometry of the ellipses (or other near-circular shape) is carefully selected, it is possible to provide a fastener with recesses which, although allowing sufficient torque to be applied in order to operate the fastener, appear to the naked eye to be approximately circular in shape. This circular appearance should deter tampering as it appears that the fastener cannot be undone with a screwdriver.

Figure 14 shows an arrangement of three concentric elliptical recesses 11-13. The elliptical nature of the recesses is somewhat exaggerated for illustrative purposes, however in practice the intention is to have as low a ratio as possible between the long and short axis of each ellipse (or other near-circular shape) in order that, on the one hand, torque can be effectively applied to operate the fastener but, on the other hand, the recesses visually approximate circles as a deterrent against tampering.

It will be apparent, however, that even if the recesses approximate a circle visually, they must in fact be non-circular in order for torque to be able to be applied to the fastener.

The other above-described security features can also be incorporated; for example the ellipses can be rotationally offset as shown in Figure 15, or axially displaced as shown in Figure 16. Figures 15 and 16 show an embodiment having two recesses 12, 13 rather than three.

In Figure 15, the two elliptical recesses 12, 13 are rotationally displaced so that the long axis D1 of recess 12 is perpendicular to the long axis D3 of recess 13. The long axis (D1, . D3) of each ellipse may be 5-10% longer than the respective short axis (D2, D4).

As can be seen from the dotted axes in Figure 16, the two elliptical recesses 12, 13 can be axially displaced.

A further security feature (not illustrated) is the provision of a push-fit cap which can be applied to the fastener once it is in place. The cap has a complementary shape to at least two of the recesses of

the fastener. Preferably the top surface of the cap is flush with the top surface 6 of the fastener to further minimise tampering.

The fastener could be manufactured using a cold forming process. A forming tool is required which includes a punch of complementary shape to the desired recesses of the fastener. The punch has a pointed end, the point having an angle in the range of 6°-30° inclusive and preferably 25°.

It is important that the pointed end is closely aligned with the longitudinal axis of the fastener which is being punched or formed, else the punch or the fastener may fail. Preferably, the pointed end of the punch is, in use, within 0.3mm of the longitudinal axis of the fastener being formed.

Figure 17A is an axial section of a fastener having recesses 11 - 13 as shown in Figure 10. The largest and smallest recesses (11 and 13 respectively) are axially and rotationally aligned hexagons whereas the intermediate recess 12 is a square which is axially displaced as shown in Figure 10.

Figure 17B is an axial section of the fastener of Figure 17A, rotated through 90°.

An additional feature, shown in Figures 17A and 17B is an alignment recess 14, below the smallest recess 13, which aids alignment of a driver bit when the fastener is in use. The point of the alignment recess 14 passes through the longitudinal axis C of the fastener.

Alignment of the driver may also be facilitated by the

provision of a tab or other marking on the driving head showing which way the driver should be inserted into the fastener. However, this feature may not be desirable in embodiments of the invention to be used in high security applications.

Figure 18A is a side view of a driver 20 suitable for use with the fastener of Figures 17A and 17B. The driver 20 has a longitudinal axis D which, when the driver is used to tighten or loosen a fastener, is colinear with the longitudinal axis C of the fastener.

The bit of the driver 20 is provided with three tiers 21-23 which are complementary in shape to the recesses 11-13 illustrated in Figure 10.

Figure 18B is a side view of the driver 20 shown in Figure 18A, rotated through 90°.

The fastener of the present invention thus provides security features which reduce the likelihood of tampering as a dedicated driver is required to operate the fastener.

CLAIMS

1. Fastener having a driving head which includes at least two superimposed non-circular recesses for receiving the bit of a driver with which driver a torque can be applied to operate the fastener, characterised in that the fastener comprises a security feature whereby said torque needs to be applied to at least two of said recesses in order to operate the fastener.

2. Fastener as claimed in claim 1 wherein the security feature further comprises at least one of said recesses having a different diameter and shape to the other(s).

3. Fastener as claimed in claim 2 wherein said at least one recess is differently shaped in lateral cross-section.

4. Fastener as claimed in claim 2 wherein said at least one recess has the same shaped lateral cross-section, but is rotationally displaced.

5. Fastener as claimed in any of claims 2-4 wherein the longitudinal axes of at least two recesses are not co-linear.

6. Fastener as claimed in any of the preceding claims wherein at least one of said recesses approximates a circle in lateral cross-section.

7. Fastener as claimed in claim 6 wherein said recess approximating a circle in lateral cross-section is an ellipse.

8. Fastener as claimed in any of the preceding claims

wherein the height of at least one of said recesses is in the range 0.5mm to 2mm inclusive.

9. Fastener as claimed in claim 8 wherein said height is 1mm.

10. Fastener as claimed in any of the preceding claims wherein the ratio of height to diameter of at least one of said recesses is in the range 0.8 to 1.2 inclusive.

11. Fastener as claimed in any of the preceding claims wherein the diameter of at least one of said recesses is not a standard metric or imperial size.

12. Fastener substantially as described herein with reference to any appropriate combination of Figures 3-18.

13. Driver for use with a fastener as described in any of the preceding claims having a bit of complementary shape to at least two of the recesses of the fastener.

14. Driver as claimed in claim 13 wherein the longitudinal axis of the driver is, in use, co-linear with the longitudinal axis of the fastener.

15. Forming tool for forming a fastener as claimed in any of claims 1-12 having a punch of complementary shape to the desired recesses of the fastener.

16. Forming tool as claimed in claim 15 wherein the punch has a pointed end, the point having an angle in the range of 6°-30° inclusive.

17. Forming tool as claimed in claim 16 wherein said angle is 25°.

18. Forming tool as claimed claim 16 or claim 17 wherein said pointed end is within 0.3mm of the longitudinal axis of the fastener being formed.

19. Push-fit cap for use with a fastener as claimed in any of claims 1-12 having a complementary shape to at least two of the recesses of the fastener.

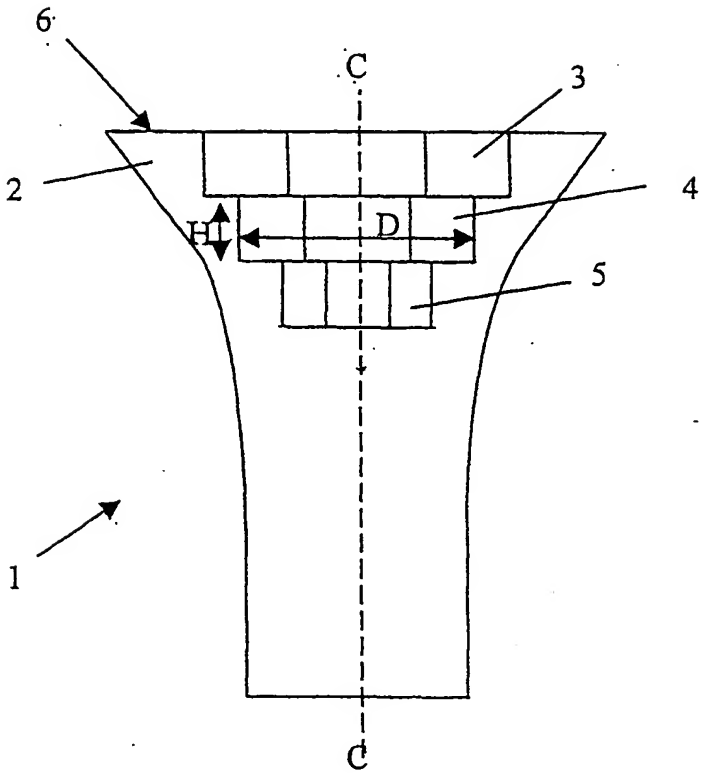

Figure 1
(Prior Art)

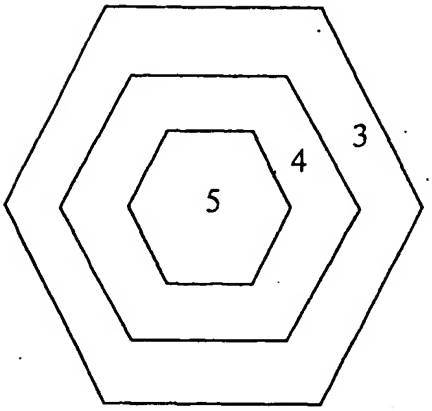

Figure 3
(Prior Art)

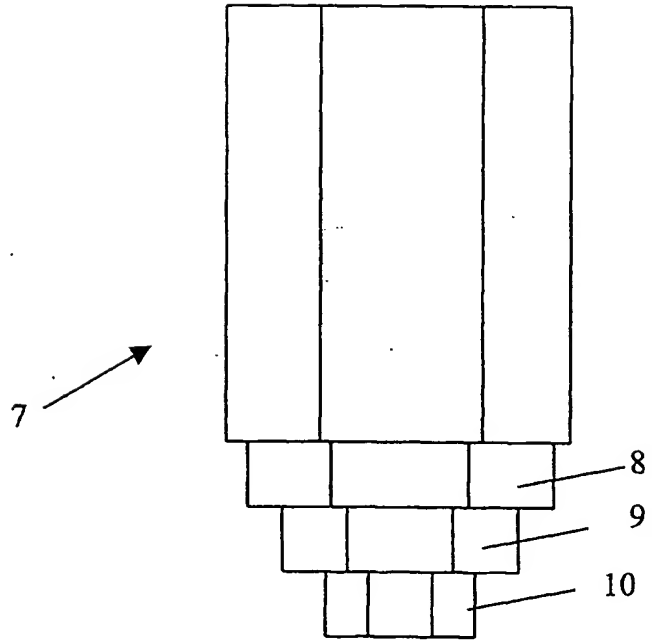

Figure 2
(Prior Art)

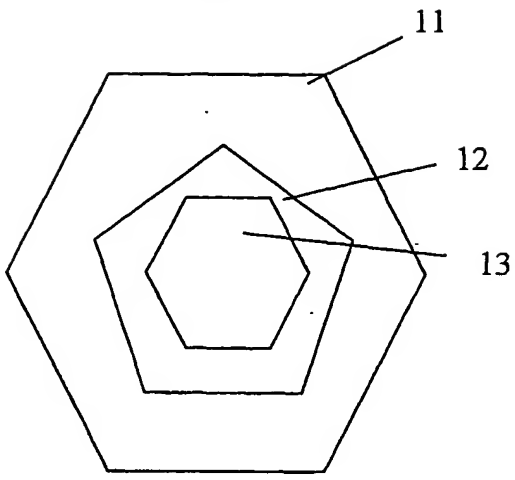

Figure 4

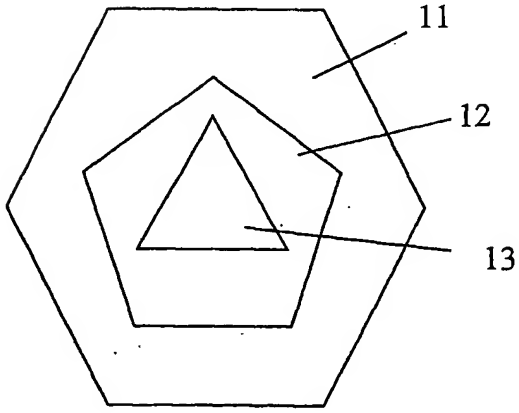

Figure 5

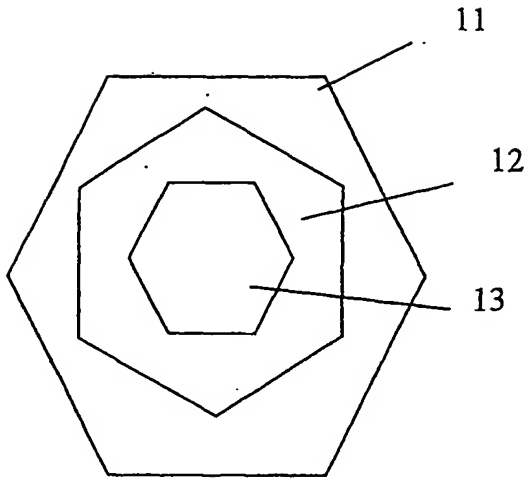

Figure 6

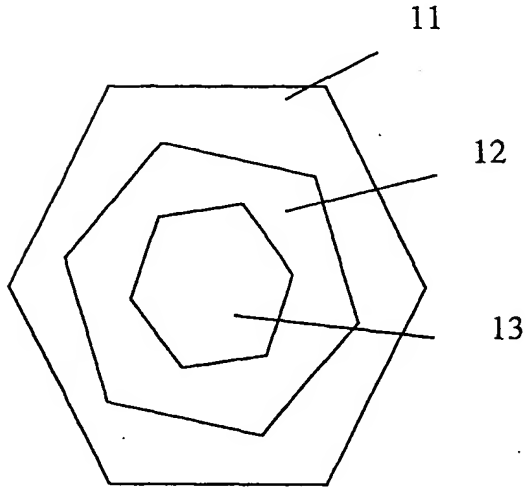

Figure 7

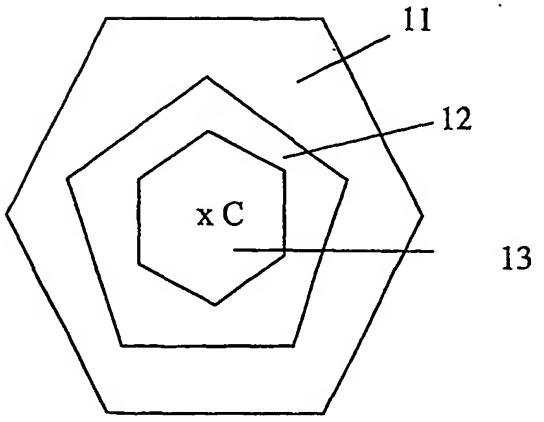

Figure 8

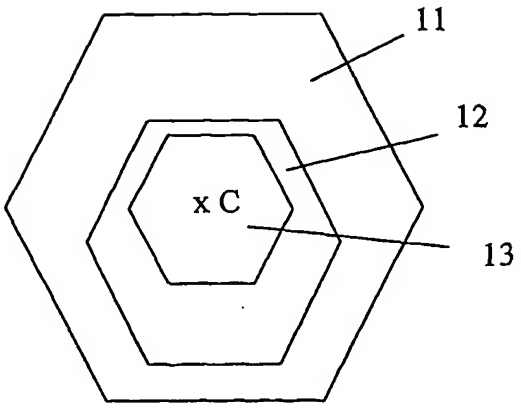

Figure 9

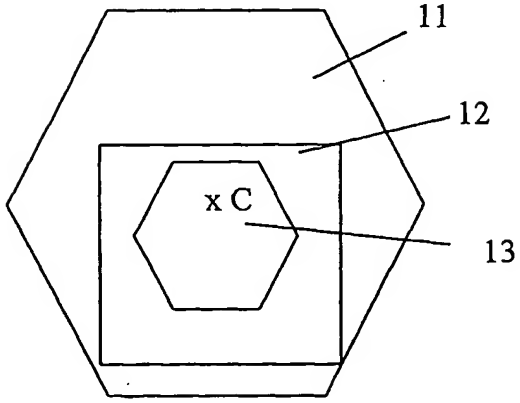

Figure 10

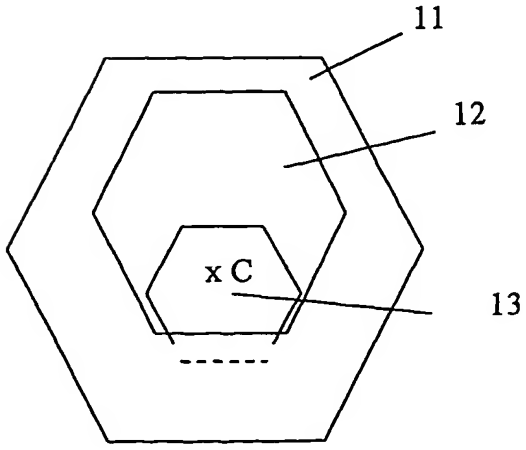

Figure 11

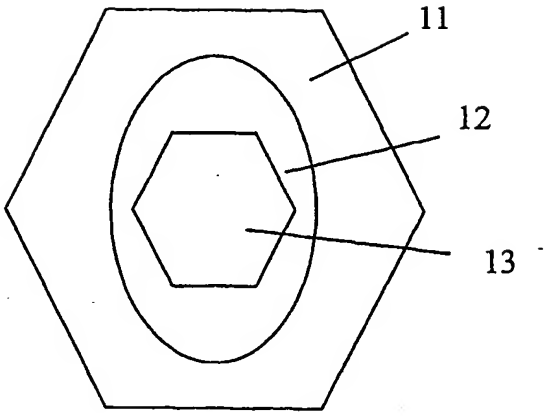

Figure 12

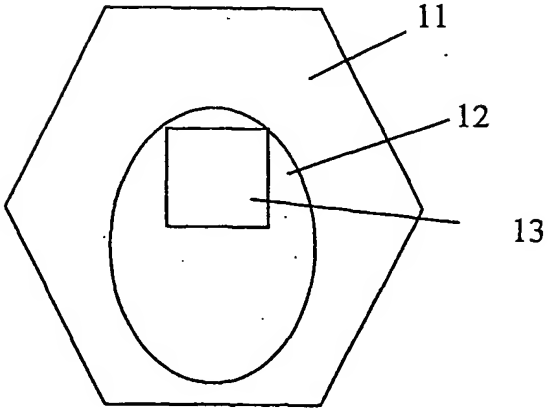

Figure 13

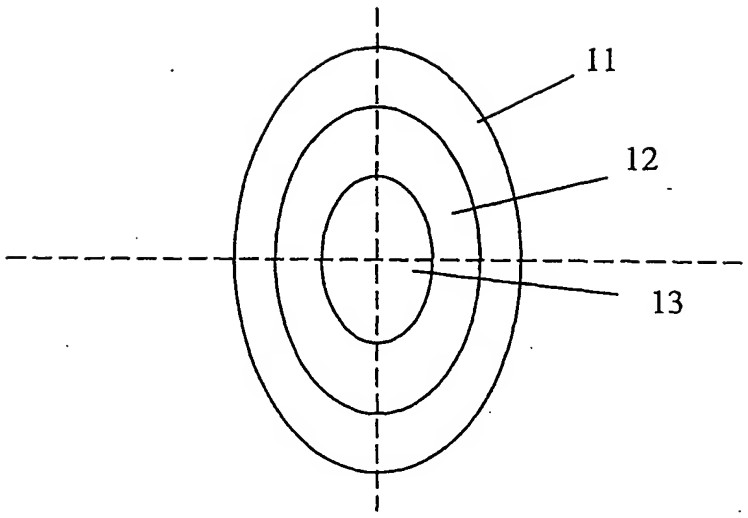

Figure 14

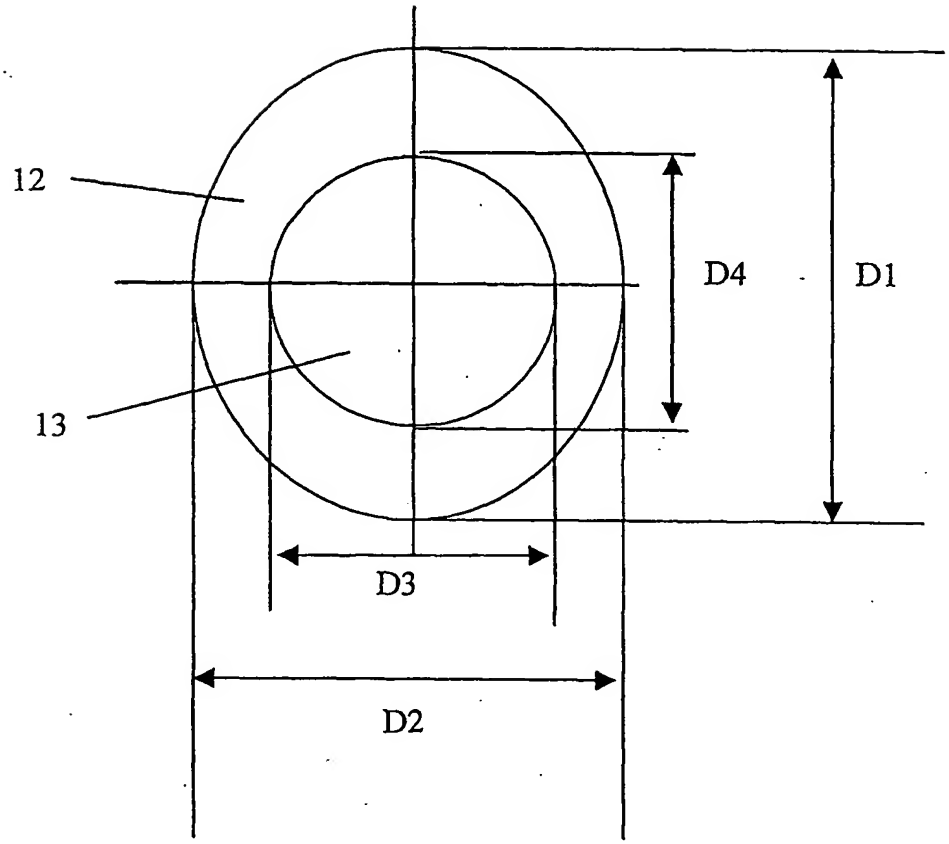

Figure 15

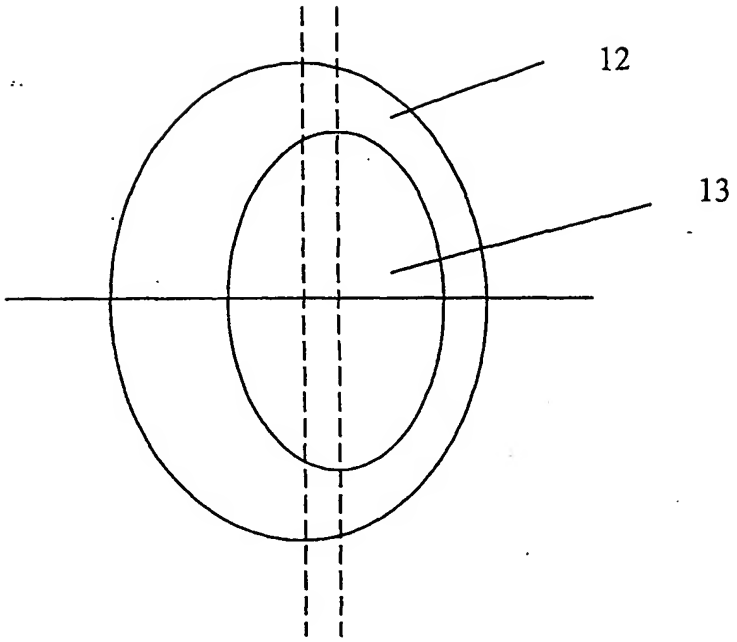

Figure 16

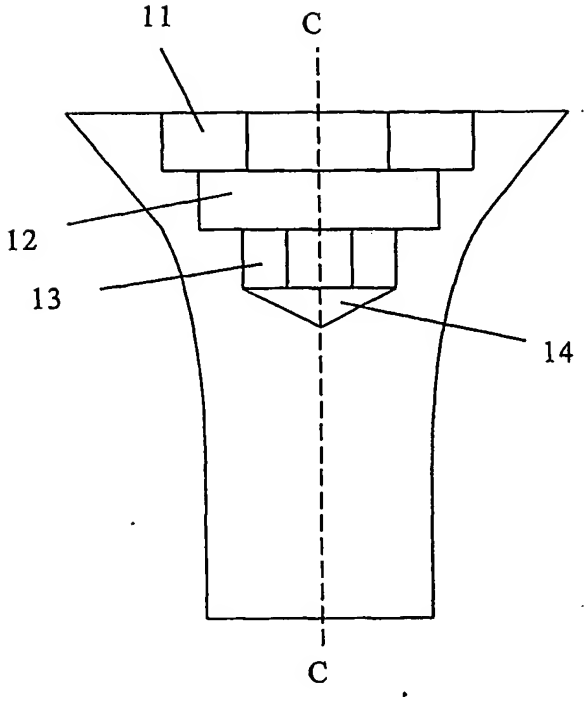

Figure 17A

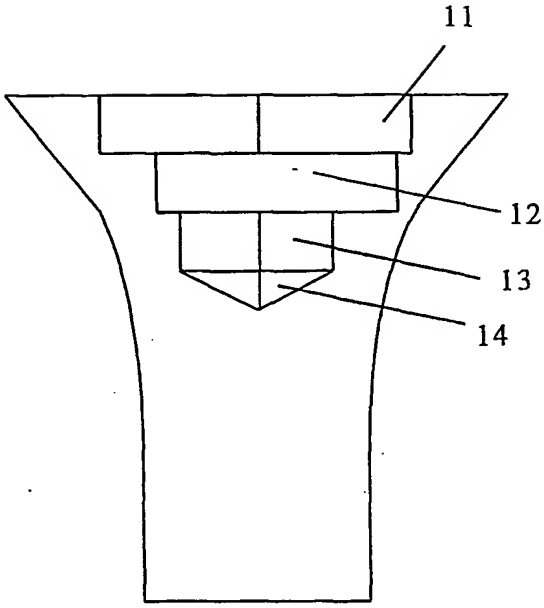

Figure 17B

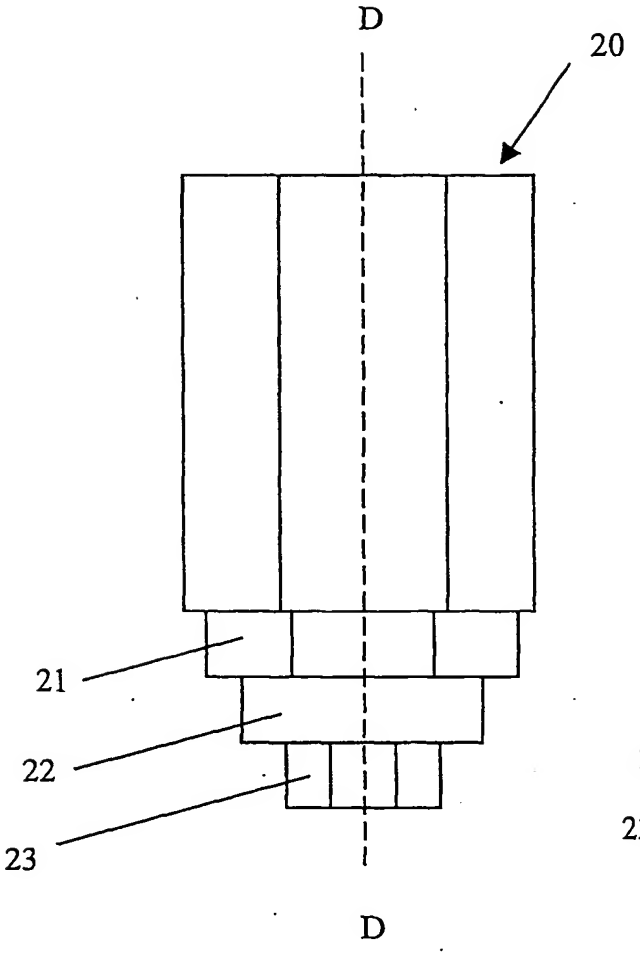

Figure 18A

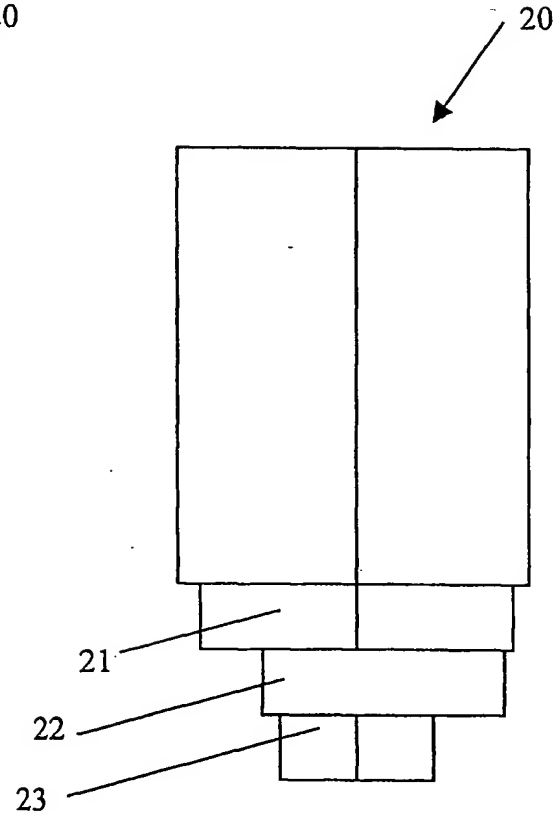

Figure 18B

INTERNATIONAL SEARCH REPORT

Internal Application No
PCT/ [illegible] 01/01404

A. CLASSIFICATION F SUBJECT MATTER
IPC 7 F16B23/00 F16B41/00 B25B15/00 B25B13/48

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F16B B25B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 463 209 A (PODOLSKY ROMAIN) 26 August 1969 (1969-08-26) cited in the application	1,2
A	figures 1-13	3-19
A	EP 0 926 362 A (LUCENT TECHNOLOGIES INC) 30 June 1999 (1999-06-30) figures 1-5	1-19
A	US 4 258 596 A (BISBING ROBERT H ET AL) 31 March 1981 (1981-03-31) figures 1-6	1-19
A	GB 2 037 390 A (B & A ENGINEERING CO) 9 July 1980 (1980-07-09) figures 1-9	1-19
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 June 2001	19/06/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Huusom, C

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INTERNATIONAL SEARCH REPORT

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PCT/GB 01/01404

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category '	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 329 947 A (BROOKS LAURENCE ANTHONY ;ROBINSON HARRY (GB)) 7 April 1999 (1999-04-07) figures 1-8	1-19

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